A Reexamination of Smoking Before, During, and After Pregnancy

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Objectives. This study examined the patterns and correlates of maternal smoking before, during, and after pregnancy.

Methods. We examined socioeconomic, demographic, and clinical risk factors associated with maternal smoking in a nationally representative cohort of women (n=8285) who were surveyed 17±5 months and again 35±5 months after delivery.

Results. Smoking rates among women with a college degree decreased 30% from before pregnancy to 35 months postpartum but did not change among the least educated women. Risk factors clustered, and a gradient linked the number of risk factors (0, 2, 4) to the percentage smoking (6%, 31%, 58%, $P<.0001$).

Conclusions. The period of pregnancy and early parenthood is associated with worsening education-related disparities in smoking as well as substantial clustering of risk factors. These observations could influence the targeting and design of maternal smoking interventions. (*Am J Public Health.* 2002;92:1801–1808)

Smoking poses a significant threat to women's health.[1] Women are more likely to stop smoking during pregnancy than at other times,[1] yet the majority who quit are smoking again within 1 year postpartum.[2–8] The lack of sustained benefit from interventions during pregnancy and postpartum[9–16] suggests that our understanding of the determinants of smoking before, during, and after pregnancy remains inadequate.

In the only national population-based longitudinal study to examine this issue, Fingerhut et al.[2] found that although 39% of smokers quit during pregnancy, 70% of them relapsed within 1 year postpartum. The lowest quitting rates were among those who smoked most before pregnancy and who had the least education. No significant risk factors for smoking relapse were identified. Although this was an important early contribution to smoking cessation research, the study included only White women, had a small sample size for examining relapse rates (n=191 quitters), and did not assess potentially important risk factors, such as income[17] and the presence of other household smokers.[3,5–7,18] A population-based, cross-sectional study found similar quitting and relapse rates but also identified African American race, parity, stressful events, and pregnancy weight gain as predictors.[8] Other studies have found additional significant factors, including marital status,[19] alcohol use,[12] and breastfeeding.[3,4] Surprisingly few studies have examined maternal depression despite the link between depression and smoking outside the context of pregnancy[20–26] and its prevalence among women with young children.[27,28]

This prior research offers a detailed but fragmented picture of the factors associated with maternal smoking. First, the relative importance of any given risk factor is difficult to interpret, because past studies each examined different sets of covariates. Second, important clinical (e.g., depressive symptoms) and social (e.g., income) risk factors remain inadequately studied. Third, no study has examined the clustering of these risk factors or assessed their cumulative effects.[29–31] Finally, small sample sizes,[3,5–7] sample homogeneity,[2] and a lack of longitudinal data[17] have further limited interpretation. The present study used data from the 1988 National Maternal and Infant Health Survey (NMIHS) and 1991 Longitudinal Follow-Up (LF), a national cohort study designed to identify factors related to poor pregnancy outcomes.[32,33] We investigated factors associated with maternal smoking trends over the course of pregnancy and the first 3 years postpartum. We examined a more comprehensive set of clinical and social factors than has been analyzed to date, for both their individual and their cumulative associations with maternal smoking behaviors.

METHODS

Sample

The 1988 NMIHS was a population-based survey of 9953 women giving birth in 1988. Sampling was based on birth certificates from 48 states and the District of Columbia; Black mothers and the mothers of low- and very low birthweight infants were oversampled. The 1988 NMIHS was administered 17±5 months after delivery, and questions about pregnancy behaviors were based on maternal recall. The 1991 LF was administered 35±5 months after delivery. Eighty-eight percent (n=8285) of the women completed the LF, and these women constitute the sample for this study. Additional information on the NMIHS has been published elsewhere.[34,35]

Measures

Outcomes. We examined four outcome measures. The first three of these outcomes came from the 1988 NMIHS and were determined by the mother's response to the following questions: "Did you smoke cigarettes during the 12 months before delivery?"; "Did you quit smoking for at least a week during your pregnancy?"; and "Do you smoke cigarettes now?" The fourth outcome, smoking at the time of the 1991 LF (35±5 months postpartum), was determined by the question "Do you smoke cigarettes now at all?" All responses were dichotomous. The predictor variables that follow were recoded to accommodate nonlinear relationships, skewed distributions, and prior approaches in the literature.

Socioeconomic and demographic variables. Maternal education (<12 years, 12 years, 13 to 15 years, ≥16 years), total household income (<$10 000, $10,000 to $19 999, $20 000 to $34 999, $35 000 to $49 999,

and ≥$50,000), Hispanic ethnicity, and marital status (currently married, never married, formerly married) were reported by the mother in the 1988 NMIHS. Maternal age (<20, 20 to 29, ≥30 years) and race came from the birth certificate. Race and ethnicity data were combined to create 4 groups (White, non-Hispanic; Black, non-Hispanic; Hispanic; other).

Clinical variables. Additional self-report measures from the 1988 NMIHS included amount smoked during the 3 months before conception (<1, ≥1 pack/day), number of drinks per week before learning of pregnancy (<1, 1 to 2, ≥3), number of drinks per week after learning of pregnancy (<1, ≥1), pregnancy intention (wanted to become pregnant at that time, did not want to become pregnant at that time), and being currently pregnant (at the time of the 1988 NMIHS). Parity (1, ≥2) and infant birthweight (<2500 g, ≥2500 g) also came from the birth certificate.

We used any intention to breastfeed as a predictor for quitting during pregnancy, and ever breastfeeding as a predictor for smoking relapse after pregnancy.[4] Maternal weight gain during pregnancy was constructed from the self-report of maternal weight before pregnancy and before delivery and was coded as either in the top quartile (≥40 lb) or below the top quartile.[8] Maternal depression was determined by the Center for Epidemiologic Studies Depression Scale, a 20-item self-report instrument included in the 1988 NMIHS. Women who scored 16 or above (out of a possible 60) were classified as having significant depressive symptoms.[36]

Contextual variables. The number of smokers (0, ≥1) living with the mother during pregnancy and the number of smokers (0, ≥1) living with the mother at 17±5 months postpartum were ascertained in the 1988 NMIHS.

Analysis

In the cross-sectional bivariate and multivariate analyses of each outcome, we used all women with available data. In the description of maternal smoking patterns over time (Figure 1) and in our longitudinal analysis, we used only those women who had outcome data available at all 4 points in time. Therefore, there is slight variation in the reported prevalence of smoking at each time point. For cross-sectional analyses, associations between independent variables and smoking outcomes were first examined in bivariate analyses. Significance was determined by the χ^2 statistic and associated *P* value. Multivariate logistic regression analyses were used to determine the independent associations of the covariates on smoking outcomes. In longitudinal analyses, we examined the association of depressive symptoms at 17±5 months postpartum with the change in smoking status between 17±5 and 35±5 months (i.e., between the 1988 and 1991 surveys). We report adjusted odds ratios (ORs) and 95% confidence intervals (CIs). All variables that were significant in the prior literature were included in the regression models and were maintained in the adjusted analyses.

We weighted analyses to reflect US women who had a live birth in 1988, using data provided by the National Center for Health Statistics. We used SAS Version 8.1 (SAS Institute Inc, Cary, NC) and SAS-callable SUDAAN Version 7.5.4A (Research Triangle Institute, Research Triangle Park, NC).

RESULTS

Twenty-nine percent of the women smoked during the 12 months before delivery, 56% quit smoking for at least 1 week during pregnancy, and the majority (72%) of women who quit were smoking again at 17±5 months postpartum (Figure 1). At 35±5 months, an additional 367 women (approximately 17% of all 1991 LF smokers) reported smoking, despite reporting no history of smoking in the 12 months before delivery. The net result was that the prevalence of smoking decreased slightly, from 29% within the 12 months before delivery to 26% at 35±5 months postpartum.

Smoking During the 12 Months Before Delivery

Compared with women who had graduated from college, women who had not graduated from high school were more than 4 times as likely to smoke during the 12 months before delivery, adjusting for covariates (Table 1). The presence of other household smokers and increased alcohol consumption had similarly strong, independent associations with increased smoking. Lower family income, unmarried status, White race, and increased maternal age were also significant predictors of smoking.

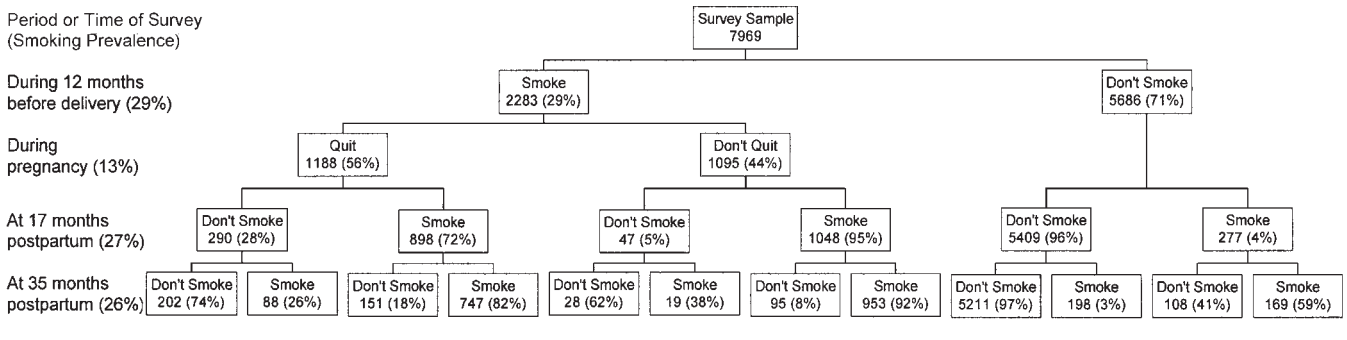

FIGURE 1—Smoking patterns before, during, and after pregnancy.

TABLE 1—Smoking Prevalence During the 12 Months Before Delivery: 1988 National Maternal and Infant Health Survey

	n	Percentage Smoking	Adjusted Odds Ratio[a]	95% CI
Total	8285	29.6	. . .	. . .
Socioeconomic variables				
Education				
< 12 y	1818	39.8	4.1	3.0, 5.6
12 y	3342	35.7	3.2	2.5, 4.2
Some college	1938	25.4	2.1	1.6, 2.8
College graduate	1187	11.7	1.0	. . .
Income, $				
< 10 000	2614	39.4	1.9	1.4, 2.7
10 000–19 999	1838	33.1	1.6	1.1, 2.1
20 000–34 999	1846	30.7	1.5	1.1, 2.0
35 000–49 999	1097	21.9	1.1	0.8, 1.5
≥ 50 000	890	16.8	1.0	. . .
Demographic variables				
Marital status				
Formerly married	777	48.2	2.2	1.7, 2.9
Never married	2721	38.2	1.6	1.3, 2.0
Married	4787	25.5	1.0	. . .
Race/ethnicity				
Black, non-Hispanic	3951	25.3	0.4	0.3, 0.4
Hispanic	680	18.4	0.3	0.2, 0.4
Other	241	8.9	0.2	0.1, 0.4
White, non-Hispanic	3413	33.9	1.0	. . .
Age at delivery, y				
< 20	1333	35.6	0.7	0.5, 1.0
20–29	4756	31.6	1.1	0.9, 1.3
≥ 30	2196	22.8	1.0	. . .
Clinical variables				
Alcohol consumption,[b] drinks/wk				
≥ 3	745	52.1	3.8	3.0, 4.8
1–2	647	37.4	2.2	1.7, 2.8
< 1	6893	25.7	1.0	. . .
Parity				
Not the first child	4903	29.2	1.1	0.9, 1.3
First child	3352	30.1	1.0	. . .
Contextual variables				
No. of household smokers				
≥ 1	2982	51.7	4.0	3.4, 4.7
0	5303	18.4	1.0	. . .

Note. CI = confidence interval.
[a]Adjusting for all variables listed.
[b]Before pregnancy.

Quitting During Pregnancy

Women who had not completed high school were one third as likely to quit smoking during pregnancy compared with women who had graduated from college, after adjusting for covariates (Table 2). Consuming 1 or more drinks per week during pregnancy, greater parity, no intention to breastfeed, and presence of other smokers in household were all independently associated with a lower likelihood of quitting during pregnancy.

Relapsing After Pregnancy

Women who lived with another smoker were 4 times as likely to relapse as women who did not live with another smoker (Table 3). Low income and less education were also significant predictors of relapse. Neither breastfeeding nor the experience of having a low-birthweight infant conferred protection against relapse. In contrast to their significant association with quitting, the amount smoked before delivery and prenatal alcohol consumption were not significant predictors of relapse. Pregnancy weight gain also had no association with relapse.

Summary of Predictors

Maternal education and household smoking had significant adverse associations with all three outcomes (Table 4). Income also had consistent, but more modest, associations across all outcomes. Black race was associated with a reduced likelihood of smoking during the 12 months before delivery but was not associated with increased quitting or lower relapse.

Depressive Symptoms and Maternal Smoking

Twenty-four percent of women screened positive for depression at 17 ± 5 months postpartum. Depressive symptoms were significantly associated with concurrent smoking (odds ratio [OR] = 1.2; 95% confidence interval [CI] = 1.0, 1.4). However, they were not associated with any change in smoking status between 17 ± 5 and 35 ± 5 months (the 1988 NMIHS and 1991 LF). Among women who were not smoking at 17 ± 5 months (n = 5746), depressive symptoms at that time did not predict smoking initiation (n = 307) between the 2 surveys (OR = 0.9; 95% CI = 0.6, 1.4). Similarly, among women who were smoking at 17 ± 5 months, depressive symptoms were not associated with continued smoking between the 2 surveys (OR = 1.1; 95% CI = 0.8, 1.7).

TABLE 2—Likelihood of Quitting for 1 Week or More During Pregnancy Among Women Who Smoked During the 12 Months Before Delivery: 1988 National Maternal and Infant Health Survey

	n	Percentage Quitting for ≥ 1 Week	Adjusted Odds Ratio[a]	95% CI
Total	2427	55.3	. . .	. . .
Socioeconomic variables				
Education				
< 12 y	699	40.0	0.3	0.2, 0.6
12 y	1073	56.3	0.6	0.4, 1.0
Some college	489	65.9	0.8	0.4, 1.3
College graduate	166	69.7	1.0	. . .
Income, $				
< 10 000	893	46.5	0.6	0.3, 1.0
10 000–19 999	572	55.0	0.8	0.4, 1.3
20 000–34 999	534	60.5	0.9	0.5, 1.5
35 000–49 999	255	56.6	0.7	0.4, 1.2
≥ 50 000	173	66.6	1.0	. . .
Demographic variables				
Marital status				
Never married	877	52.3	1.0	0.7, 1.4
Formerly married	347	51.1	1.1	0.7, 1.6
Married	1203	57.3	1.0	. . .
Race/ethnicity				
Black, non-Hispanic	1039	49.4	0.9	0.7, 1.3
Hispanic	138	62.4	1.2	0.7, 2.0
Other	33	47.0	0.5	0.1, 1.8
White, non-Hispanic	1217	55.8	1.0	. . .
Age at delivery, y				
< 20	305	65.6	3.2	1.9, 5.3
20–29	1489	55.3	1.7	1.3, 2.3
≥ 30	633	48.2	1.0	. . .
Clinical variables				
Alcohol consumption,[b] drinks/wk				
≥ 1	177	36.5	0.5	0.3, 0.9
< 1	2250	56.2	1.0	. . .
Parity				
Not the first child	1542	47.2	0.6	0.5, 0.8
First child	877	66.1	1.0	. . .
Amount smoked,[3] packs/d				
≥ 1	1043	41.8	0.3	0.3, 0.4
< 1	1384	68.6	1.0	. . .
Intention to breastfeed				
No	1482	46.7	0.5	0.4, 0.6
Yes	828	66.1	1.0	. . .
Pregnancy intention				
Not at that time	1359	51.2	0.8	0.6, 1.1
At that time	1068	59.5	1.0	. . .
Contextual variables				
No. of household smokers				
≥ 1	1340	50.1	0.6	0.5, 0.8
0	1087	62.6	1.0	. . .

Note. CI = confidence interval.
[a]Adjusting for all variables listed.
[b]During pregnancy.
[c]Before pregnancy.

Disparities in Smoking Over Time and Across Risk Factors

Education-related disparities in smoking rates increased over time. This increasing disparity was the result of the independent association of low education with both reduced likelihood of quitting and increased likelihood of later relapse. Smoking rates among women with a college degree decreased 30% from within 12 months before delivery to 35 ± 5 months postpartum (11.7% ± 1.1% to 8.3% ± 1.0%). In contrast, smoking rates among women with less than a high school degree did not decrease (39.9% ± 1.7% to 41.1% ± 1.8%). The net effect, therefore, was an increase in the relative disparity in smoking over the approximately 4-year window of time.

We examined the clustering of 5 risk factors found to be independently associated with current smoking at the time of the 1988 NMIHS. The risk factors were low income (<$20,000/year), less education (≤ high school), living with another smoker, depressive symptoms (Center for Epidemiologic Studies–Depression Scale score ≥ 16), and alcohol consumption (≥ 3 drinks/week). Twenty-seven percent of all women had 2 risk factors, 18% had 3, and 7% had 4 or 5. A more detailed examination of smokers with depressive symptoms (n = 849), for example, showed that 57% lived in households with another smoker, 67% lived in low-income households, and 83% had no education beyond high school. Women with 0, 2, and 4 of these risk factors smoked at rates of 5.7%, 30.7%, and 58.1% ($P < .00001$), respectively.

DISCUSSION

Using a national sample with comprehensive demographic and clinical data, this study offers the fullest accounting to date of the patterns and correlates of smoking before, during, and after pregnancy. Three central findings emerge from this study relating to (1) the salient independent predictors of smoking outcomes, (2) the surprising lack of association between depressive symptoms and a change in smoking status, and (3) the disparities in smoking rates over time and across risk factors.

TABLE 3—Relapse Rates at 17 ± 5 Months Postpartum Among Women Who Quit Smoking for at Least 1 Week During Pregnancy: 1988 National Maternal and Infant Health Survey

	n	Percentage Relapsed	Adjusted Odds Ratio[a]	95% CI
Total	1249	72.0	. . .	. . .
Socioeconomic variables				
Education				
< 12 y	265	83.6	3.3	1.4, 8.0
12 y	570	74.5	1.9	1.0, 3.8
Some college	301	65.5	1.3	0.7, 2.5
College graduate	113	53.4	1.0	. . .
Income, $				
< 10 000	380	79.3	2.3	1.1, 4.8
10 ,000–19 999	300	76.2	1.9	1.0, 3.9
20 000–34 999	312	71.2	1.5	0.8, 2.8
35 000–49 999	144	67.2	1.5	0.7, 3.1
≥ 50 000	113	52.6	1.0	. . .
Demographic variables				
Marital status				
Never married	420	76.2	1.0	0.6, 1.8
Formerly married	161	79.4	1.9	1.0, 3.7
Married	668	69.2	1.0	. . .
Race/ethnicity				
Black, non-Hispanic	496	81.5	1.6	1.0, 2.7
Hispanic	90	66.3	0.6	0.3, 1.1
Other	16	98.4	11.8	2.6, 55.0
White, non-Hispanic	647	70.7	1.0	. . .
Age at delivery, y				
< 20	185	78.5	0.5	0.2, 1.1
20–29	768	70.6	0.7	0.4, 1.2
≥ 30	296	70.5	1.0	. . .
Clinical variables				
Alcohol consumption,[b] drinks/wk				
≥ 1	54	75.7	1.0	0.4, 2.1
< 1	1195	71.8	1.0	. . .
Parity				
Not the first child	689	69.9	0.7	0.5, 1.0
First child	556	73.9	1.0	. . .
Amount smoked,[c] packs/d				
≥ 1	399	76.1	1.4	0.9, 2.1
< 1	850	69.5	1.0	. . .
Actual breastfeeding				
No	726	76.1	1.2	0.8, 1.7
Yes	482	68.5	1.0	. . .
Birthweight, g				
< 2500	385	79.8	1.5	1.0, 2.2
≥ 2500	864	71.3	1.0	. . .
Pregnant at 17 mo postpartum				
Yes	115	42.2	0.2	0.1, 0.4
No	1132	75.1	1.0	. . .

Continued

Predictors of Smoking Outcomes

Women with less education were more likely to smoke before delivery, less likely to quit during pregnancy, and more likely to relapse after delivery. The strengths of these relationships were striking even after adjustment for household income and other demographic covariates. Fingerhut et al.[2] found associations of a similar magnitude between education levels and smoking rates before pregnancy as well as quitting rates but, in contrast, did not find that education levels predicted a postpartum relapse. This discrepancy may be due to power differences between their study and the current one. Given that in 1988 approximately 75% of all women smokers with young children had a 12th-grade education or less, future intervention trials should include a greater focus on these women, ensuring representation in study samples and appropriate educational materials.

A strong relationship was confirmed between the presence of other household smokers and an increased risk of postpartum relapse. The effect of partner smoking has been documented in prior studies,[3,5–7,12,15,18] and the more complete accounting for covariates in this study made little difference to the estimated effect. Studies in the general adult population have shown that such contextual smoking cues produce a desire to smoke.[37] Recent animal research and human neuroimaging studies of addiction have suggested that the contextual cues themselves become directly associated with powerful neurobiological responses.[38,39] The association of household smokers with postpartum relapse stands in some contrast to the weaker association of household smokers with quitting. It is not surprising that factors uniquely related to quitting may play a moderating role. For example, other smokers' support for the woman's quitting during pregnancy is likely stronger than their support for relapse prevention after delivery.[5,18] Intervention research directed at changing the behavior of other household smokers appears to be an important area for future work.

Neither parity nor birthweight was associated with protective effects. Presumably,

TABLE 3—*Continued*

Prenatal weight gain, lb				
>40	390	70.3	0.8	0.6, 1.2
≥40	859	73.0	1.0	. . .
Contextual variables				
No. of household smokers				
≥1	574	85.4	3.9	2.6, 6.0
0	653	58.9	1.0	. . .

Note. CI = confidence interval.
[a]Adjusting for all variables listed.
[b]During pregnancy.
[c]Before pregnancy.

TABLE 4—Predictors of Smoking Status Before, During, and After Pregnancy, Adjusted Odds Ratios[a]: 1988 National Maternal and Infant Health Survey

	Smoking During 12 Months Before Delivery	Quit Smoking ≥1 Week During Pregnancy	Smoking Relapse by 17±5 Months Postpartum
Socioeconomic variables			
Lowest education	+++	−−−	+++
Lowest income	+	−	++
Contextual variables			
Household smokers	+++	−−	+++
Demographic variables			
Single marital status	++	NS	NS
Black race	−−	NS	NS
Younger age at delivery	+	+++	NS
Clinical variables			
Alcohol consumption	+++[b]	−[c]	NS[c]
Higher parity	NS	−	NS
Amount smoked[b]		−−−	NS
Pregnancy unintended		NS	
Intend to breastfeed		−−	
Actual breastfeeding			NS
Prenatal weight gain			NS
Lower birthweight			+
Pregnant at 17 mo postpartum			−−−

[a]−−− = OR ≤ 0.33; −− = OR 0.34 to 0.50; − = OR 0.51 to 0.99; + = OR 1.01 to 1.99; ++ = OR 2.00 to 2.99; +++ = OR ≥ 3.00; NS = nonsignificant in that the 95% confidence interval of the adjusted odds ratio includes 1.0.
[b]Before pregnancy.
[c]During pregnancy.

multiparous mothers have had increased contact with health providers and therefore an increased "dose" of health education about smoking. However, consistent with Cnattingius and Thorslund's results,[19] increased parity was associated with a lower rate of quitting. Perhaps a third factor, such as a woman's attitude of diminished investment toward her own reproductive health and toward the health of the fetus, increases parity and reduces quitting. However, controlling for unintended pregnancy had no effect in the model of quitting. Women who have previously delivered a healthy infant despite smoking may also be less motivated to quit in subsequent pregnancies.

Having a low-birthweight infant did not protect against relapse, despite presumed contact with physicians after the pregnancy. One difficulty may lie in the relative elevation of prenatal quitting messages over messages that emphasize the risk associated with smoking outside the context of pregnancy. Women who deliver low-birthweight infants despite quitting (for at least a week) may have been given little reason to "stay quit" after pregnancy. The stress of caring for a low-birthweight baby may also promote relapse. Alternatively, women with a low-birthweight infant may be more inclined to overreport having quit during pregnancy; thus, these women would appear to have higher relapse rates. In contrast to other studies, this study did not find that postpartum breastfeeding[4] protected against postpartum relapse and did not find that excessive pregnancy weight gain[8] had an adverse effect on postpartum relapse. Controlling for a larger number of covariates in our analyses (e.g., including other household smokers) may in part explain the different findings.

Lack of Association Between Depressive Symptoms and Change in Postpartum Smoking Status

Maternal depressive symptoms were associated with concurrent smoking status. Surprisingly, they were not associated with a change in smoking status. These results contrast with those of Anda et al.,[20] who found that in the general population, depressive symptoms significantly decrease the likelihood of subsequent quitting. Studies focusing on the relationship between depression and smoking cessation during pregnancy have had mixed results.[40–42] A postpartum relapse prevention trial found that poor mental health 12 months after delivery was associated with having relapsed.[15] Hanna et al.,[43] using the 1988 NMIHS data, suggested that depressive symptoms influence smoking during pregnancy, but their study examined fewer covariates than this study, and the depressive symptoms were assessed well after delivery. Nevertheless, the high rates of both postpartum depression and smoking relapse suggest that further additional prospective research is needed to clarify this complex relationship.

Disparities in Smoking Over Time and Across Risk Factors

This study demonstrates that the relative health disadvantage associated with low maternal education is dynamic and continues to accrue over a time period that is rich in health care contacts. The elimination of health disparities is now a major national health goal.[44,45] As more efficacious treatments for smoking emerge,[46] however, there is a risk that social disparities in smoking rates may actually increase if there are persistent differentials in knowledge about and access to these treatments.[47] The rising Black-to-White differential in sudden infant death syndrome is one example of an increased health disparity between these groups that has resulted from an intervention (in this case, a campaign to change infants' sleep position).[48]

Our findings support the prior literature in delineating a series of independent risk factors associated with maternal smoking. However, the results also demonstrate that these "independent" risk factors cluster together. This clustering suggests the need for a more comprehensive and integrated approach across women's many health care contacts. It may also suggest the need for a broader notion of "well-women's care" with the goal of maintaining the positive health trajectory achieved during pregnancy. Specifically, the clustering of risk factors suggests that new interventions may be required for long-term success. This may include, for example, removing financial barriers to nicotine replacement therapy, focusing on the treatment of comorbid depression or alcohol problems, and changing the behavior of other household smokers.

Several limitations of this study exist. All smoking behaviors were by maternal self-report, and behaviors during pregnancy were recalled approximately 17 months after delivery. Social desirability might lead to a biased recall of smoking. For example, underreporting of smoking might be more pronounced among highly educated women or women who had relapsed. However, self-reported smoking status, even well after the pregnancy, is reasonably accurate,[49–51] and less educated women may actually be more likely to underreport smoking.[52] Another limitation is that the outcomes lack detail. We cannot ascertain in which trimester the women quit smoking, whether the women did not smoke for the remainder of the pregnancy, and indeed whether some women quit before conception. The reported associations are not necessarily causal. An unobserved factor, such as a capacity to delay gratification, may jointly determine both the amount of education and smoking behavior.[53] It is also important to note that the prevalence of smoking among pregnant women has decreased substantially since 1988. Nevertheless, the current social patterning of smoking may be as great, if not greater, than in 1988.[54] Finally, the 88% response rate for the 1991 LF may bias the findings (e.g., relating to depressive symptoms), although the direction of the potential bias is unclear.

We used a nationally representative longitudinal cohort to examine the risk factors associated with smoking and relapse during the window of pregnancy and early parenthood. Of particular note was the powerful relationship between other household smokers and maternal relapse. In addition, we found that education-related disparities in smoking grew over a time period relatively rich in health care contacts and that the disparities rose sharply with an increasing number of clinical and social risk factors. Comprehensive interventions are needed that promote integration across health care contacts and that address the co-occurring morbidity that may constrain women's efforts to quit. ■

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This article was accepted March 10, 2002.

Contributors

R.S. Kahn conceived of the study, designed and assisted in the analysis, and wrote the article. L. Certain assisted in the design and analysis and cowrote the article. R.C. Whitaker assisted in the conception of the study, interpretation of the results, and editing of the article.

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